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Biological Risks, Economic Drivers and Intervention Benefits of High-Fat-Sugar Takeaway for Urban Adolescents

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Abstract. With the rapid prevalence of digital catering services, takeaway consumption has evolved into a prevalent lifestyle among Generation Z, particularly adolescent students, triggering widespread concerns about youth dietary health. Frequent takeaway intake is associated with low nutritional value of food and harmful chemical substances in packaging, which imposes latent long-term physical hazards and threatens adolescent physical development and public health. This paper explores multi-dimensional factors affecting teenagers' takeaway consumption behavior from personal and platform perspectives, and systematically analyzes the hidden health risks of long-term frequent takeaway consumption. Corresponding targeted improvement strategies are proposed matching the three dimensions of individuals, catering platforms and government regulation. On the personal level, improving self-discipline and cultivating independent cooking skills can effectively reduce takeaway dependence. Platform-side rectification includes cancelling preferential inducements and clearly marking food calories and ingredients. Governments can regulate unhealthy catering consumption through targeted taxation on sugary products. Though these interventions have minor limitations, their health and social benefits are prominent. The research integrates public health and economic perspectives to reveal essential causes of unhealthy dietary behaviors, providing practical references for standardizing youth eating habits, improving public health levels and reducing dietary-related health risks.

Keywords: Public health, consumption habits, takeaway, government strategies

1. Introduction

Driven by digital economy development and mobile Internet penetration, online food delivery has become a dominant dietary mode for Chinese urban adolescents, completely replacing traditional dining and home cooking lifestyles [1]. Convenient ordering procedures and diverse catering options enable high-fat and high-sugar foods represented by fried fast food and sugar-sweetened beverages to transform from occasional indulgences into daily staple diets for teenagers. Epidemiological data show that 39.8% of Chinese adolescents consume Western fast food 1–2 times weekly, and adolescents with more than four weekly takeaway orders exhibit a 2.3-fold higher risk of metabolic syndrome than rare users, indicating a severe correlation between frequent takeaway consumption and adolescent metabolic health damage [2]. In the context of declining adolescent physical fitness

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and rising youth chronic disease incidence, exploring the health hazards and driving mechanisms of unhealthy takeaway consumption is of great significance for adolescent health management and public health prevention.

Current global research on takeaway dietary health risks presents obvious regional differences in research paradigms. Western studies mainly adopt long-term cohort tracking and clinical experimental designs, systematically confirming that long-term high-fat and high-sugar dietary intake induces obesity, insulin resistance, cardiovascular stiffness and other cardiometabolic abnormalities, and verifying the cumulative long-term harm of unhealthy diets across the life cycle [3]. Domestic research in China focuses more on large-scale cross-sectional epidemiological surveys, exploring the correlation between takeaway consumption frequency, dietary structure and adolescent obesity, and comparing urban-rural dietary behavioral differences [4]. However, existing studies have obvious research limitations: most studies independently discuss biological health hazards or behavioral influencing factors, lacking integrated analysis of economic driving mechanisms, platform operational logic and adolescent psychosocial characteristics. Few studies construct a holistic analytical framework linking industrial operation, individual behavior and health outcomes.

Furthermore, current academic research lacks targeted attention to middle-income urban adolescents, a high-risk group susceptible to platform marketing incentives [4]. This group has stable disposable pocket money and time constraints from heavy academic tasks, making them the core target of platform discount strategies and algorithmic recommendation mechanisms, yet their dietary behavioral formation mechanisms and health risks have not been systematically summarized. Based on a small-scale questionnaire survey of 40 underage middle-income adolescents, this study summarizes their typical takeaway consumption characteristics dominated by bubble tea and fried fast food. On this basis, this paper constructs a multi-dimensional analytical framework covering biological risk mechanism, economic driving logic, psychosocial long-term consequences and multi-subject intervention optimization, aiming to reveal the full-chain formation mechanism of adolescent unhealthy takeaway habits and provide targeted, operable public health intervention strategies to fill the gaps in existing domestic and international research.

2. Biological damages of long-term high-fat and high-sugar takeaway consumption

High-fat and high-sugar takeaway foods represented by fried chicken, milk tea and processed fast food are characterized by high calorie, unbalanced nutrition, excessive saturated fat and added sugar [2]. Occasional consumption can be metabolized and tolerated by the human body, but long-term frequent intake will continuously impact multiple physiological systems, inducing sub-health states and latent chronic disease risks in adolescents. The metabolic system is the first and most directly damaged physiological system affected by unhealthy takeaway diets.

Long-term high sugar intake disrupts human blood glucose homeostasis and induces early insulin resistance [5]. A large amount of sucrose and fructose in milk tea and sweetened staple foods is rapidly absorbed by the intestinal tract after ingestion, causing sharp fluctuations in postprandial blood glucose. Sustained high blood glucose stimulates excessive insulin secretion from pancreatic β-cells to maintain glycemic stability. Long-term excessive insulin stimulation gradually reduces the insulin sensitivity of peripheral tissue cells, forming insulin resistance, the core pathological basis of type 2 diabetes [5]. Meanwhile, excessive saturated fatty acids and trans fats in fried takeaway foods significantly elevate low-density lipoprotein levels and reduce high-density lipoprotein content, leading to dyslipidemia [2]. The combination of insulin resistance and dyslipidemia constitutes the

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core diagnostic criteria of adolescent metabolic syndrome, greatly increasing the risk of adult-onset metabolic diseases [2].

In addition to metabolic disorders, long-term unhealthy takeaway diets cause latent vascular endothelial damage and increased arterial stiffness in adolescents [6]. Persistent high-sugar intake promotes the massive accumulation of advanced glycation end-products in vascular tissues, which directly damage vascular endothelial cell structure and function, reduce arterial wall elasticity, and accelerate the progression of early atherosclerosis [6]. Although adolescents have strong vascular compensatory capacity and no obvious clinical cardiovascular symptoms, subclinical vascular damage has already formed. A cross-sectional study confirmed that individuals with weekly takeaway consumption have significantly higher pulse wave velocity, systolic blood pressure and diastolic blood pressure than rare consumers, proving that frequent takeaway intake accelerates vascular aging in young populations [7].

Moreover, high-fat and high-sugar diets severely disrupt intestinal microecological balance and induce systemic chronic low-grade inflammation [8]. Long-term unhealthy dietary patterns alter the composition and abundance of gut microbiota, inhibiting the proliferation of beneficial probiotics and promoting the enrichment of pathogenic bacteria. Imbalanced gut flora increases intestinal mucosal permeability, allowing endotoxins to enter the blood circulation and trigger persistent low-grade inflammatory responses [8]. This chronic inflammatory state is closely associated with the occurrence of non-alcoholic fatty liver disease, autoimmune disorders and metabolic disorders. The cumulative invisible damage of intestinal microecology and systemic inflammation during adolescence further consolidates the risk of chronic diseases in adulthood.

3. Economic factors driving unhealthy takeaway consumption

The prevalence of adolescent unhealthy takeaway consumption is not merely a result of individual dietary preference, but a behavioral outcome jointly driven by merchant profit mechanisms, platform operational strategies and adolescent time-economic rationality [9]. The tripartite interest interaction forms a stable behavioral incentive loop, continuously promoting the high-frequency consumption of high-fat and high-sugar takeaway foods.

From the merchant perspective, high-fat and high-sugar fast food products have inherent cost advantages and high profit margins [9]. Fried foods and milk tea drinks adopt standardized assembly-line production, with low raw material costs and no reliance on professional chefs, which greatly reduces labor and operating costs. The high gross profit margin allows merchants to bear platform discounts, coupon subsidies and bundled sales activities. Merchants rely on high sales volume to achieve profit stability, forming a sustainable low-cost and high-volume business model for unhealthy takeaway catering [9]. In contrast, healthy light meals and low-sugar diets have higher ingredient costs and complex production processes, lacking market competitiveness in discount activities, thus occupying a minor market share in adolescent takeaway consumption.

Online catering platforms further amplify unhealthy consumption tendencies through algorithmic recommendation and precision marketing mechanisms [9]. Fierce industry competition forces platforms to continuously launch full-scale subsidies, member red envelopes, threshold discounts and free delivery services. Threshold preferential policies such as "spend 30 RMB off 15 RMB" stimulate adolescent impulse consumption and increase per capita order amount. More importantly, personalized recommendation algorithms form closed-loop marketing: after users purchase fried fast food or milk tea, the platform continuously pushes similar high-fat and high-sugar products on the homepage, repeatedly stimulating consumption desire [9]. All marketing strategies are precisely

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targeted at time-sensitive and budget-limited student groups, matching the consumption capacity and living rhythm of middle-income adolescents.

For adolescent consumers, time cost and economic affordability are the core driving factors of takeaway dependence [4]. Urban middle school students face intensive academic schedules with extremely fragmented daily spare time. Takeaway delivery saves the time of canteen queuing and meal preparation, providing longer rest and study time for students. Meanwhile, the unit price of 20–50 RMB per takeaway meal fully matches the daily pocket money budget of middle-income families, and high-frequency weekly ordering will not cause family economic pressure [4]. Under the dual constraints of time scarcity and budget adequacy, adolescents naturally prioritize convenient and cost-effective high-fat and high-sugar takeaway products, while nutritionally balanced healthy meals are ignored due to time cost and taste factors.

4. Multi-subject intervention mechanisms and benefit analysis

Adolescent unhealthy takeaway consumption is a comprehensive social problem involving government supervision, platform operation, merchant management and individual behavior, so interventions need to rely on multi-stakeholder collaborative governance. Current mainstream intervention measures include government policy supervision, platform self-regulation and family-individual education, each with unique governance effects and inherent limitations.

Government intervention focuses on mandatory policy regulation and public health guidance [10]. The core measures include mandatory online nutritional information labeling, sugar tax imposition on sugary drinks, and strict restriction of high-fat and high-sugar food advertising for teenagers. Government intervention has the advantages of wide coverage and strong normative force, which can standardize the overall development of the online catering industry from the macro level [10]. However, government regulation has obvious shortcomings of high implementation cost and time lag. Adolescents with fixed dietary habits have low sensitivity to nutritional labels and policy guidance, and sugar tax policies cannot effectively curb the consumption willingness of loyal users, resulting in limited actual behavioral intervention effects and obvious negative externalities of policy implementation [10].

Platform self-regulation mainly includes healthy food labeling, priority recommendation of low-sugar and low-fat meals, and personalized dietary health reminder services [11]. Platforms cooperate with professional nutrition institutions to optimize search algorithms and increase the exposure rate of healthy meals, which can subtly guide user dietary choices [11]. Nevertheless, platform self-regulation faces fundamental interest conflicts. The core profit model of food delivery platforms relies on order volume and transaction volume. Actively restricting users' unhealthy consumption will directly reduce platform revenue, resulting in most healthy regulation measures remaining symbolic and lacking substantive promotion and implementation intensity.

Family and individual intervention is the most flexible micro-level governance method [4]. Parents can restrict adolescent takeaway consumption by controlling pocket money and formulating monthly catering budgets. Schools can carry out nutritional health education courses to improve teenagers' nutritional literacy and risk awareness of unhealthy diets [4]. Individual intervention can realize personalized targeted guidance, but its effect is extremely dependent on adolescent self-discipline and family supervision. Without external institutional constraints, it is difficult to form long-term sustainable behavioral changes, and adolescents are prone to rebound to original unhealthy consumption habits after short-term improvement.

Comparative intervention effect analysis shows that price-based fiscal intervention represented by sugar tax and minimum pricing regulation has the most immediate and significant behavioral

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modification effect [10]. Direct economic constraints can effectively reduce the high-frequency consumption of high-sugar and high-fat takeaways, achieving rapid behavioral intervention. However, such policies face huge market resistance and public acceptance pressure, making them difficult to implement and promote on a large scale in the short term [10].

5. Psychosocial characteristics and long-term cumulative consequences

In addition to physiological metabolic damage, frequent takeaway consumption also induces potential psychosocial and behavioral habit problems, forming long-term cumulative adverse effects on adolescent growth and development [4]. Long-term dependence on takeaway catering hinders the cultivation of adolescents' dietary autonomy and nutritional literacy. Adolescents who lack cooking experience cannot intuitively understand food ingredients, nutritional collocation and portion control, resulting in insufficient ability to independently judge dietary health [4]. Long-term acceptance of pre-packaged takeaway meals disconnects teenagers from real food production and nutritional information, forming blind consumption habits dominated by taste and price rather than health, which will affect their independent dietary decision-making ability in adulthood.

Peer social norms further solidify unhealthy takeaway habits among adolescent groups [9]. Group ordering, discount code sharing and takeaway communication have become common social behaviors among students. Platform social incentive mechanisms strengthen group consistent consumption behaviors, making high-fat and high-sugar takeaway consumption a normalized group lifestyle [9]. Adolescents tend to conform to peer consumption choices to obtain social identity, and independent healthy consumption requires higher psychological cost, which further increases the difficulty of behavioral intervention.

Adolescent dietary patterns have significant life-cycle continuity [3]. Unhealthy high-fat and high-sugar dietary habits formed in adolescence will continue to university and working stages. The increased life pressure and faster pace of adult life will further strengthen convenient takeaway consumption habits [3]. The metabolic damage, vascular aging and intestinal microecological imbalance caused by long-term unhealthy diets are cumulative and irreversible. By the time clinical chronic disease symptoms appear in adulthood, the pathological damage has been difficult to reverse [7, 8]. In addition, emerging studies have confirmed that high-sugar and high-fat diets are correlated with emotional fluctuation, sleep disorders and poor academic performance, indirectly affecting adolescent mental health and comprehensive development [8].

6. Targeted optimization and improvement strategies

Based on the differential advantages and limitations of multi-subject interventions, this study proposes optimized targeted improvement strategies for governments, platforms, merchants and families to build a collaborative whole-chain intervention system. For regulatory authorities, mandatory standardized nutritional labeling should be implemented to replace voluntary labeling rules, requiring calorie, sugar and fat content information to be prominently displayed on the ordering interface instead of hidden details [10]. Strict supervision on takeaway advertising and promotional activities around primary and secondary school campuses should be strengthened to prohibit targeted marketing of high-fat and high-sugar products to adolescent groups. Moderate fiscal taxation policies can be steadily promoted to increase the economic cost of unhealthy food consumption and guide rational consumption [10].

For food delivery platforms, algorithmic recommendation mechanisms need to be optimized to increase the weight and exposure of healthy low-sugar and low-fat meals in personalized pushing

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[11]. A real-time health reminder mechanism can be added before order payment: when the single-meal calorie, sugar or fat intake exceeds the daily recommended standard, an intuitive pop-up reminder is triggered to restrain adolescent impulse consumption. Platforms should appropriately reduce excessive threshold discounts for unhealthy foods to weaken behavioral incentive effects.

For catering merchants, incremental healthy improvement of product lines should be realized. On the premise of retaining mainstream products, low-sugar, low-oil and low-fat alternative options are provided, such as grilled meat instead of fried meat and less-sugar drinks instead of full-sugar products, to enrich adolescent healthy consumption choices [4].

For families and individual adolescents, a dual supervision mechanism of budget constraint and self-discipline management should be established. Parents can set a monthly takeaway consumption budget through family shared payment cards to control total consumption frequency. Adolescents can formulate personal dietary rules to limit high-fat and high-sugar takeaway orders within 2 times a week, forming stable healthy dietary habits.

7. Conclusion

This study systematically explores the multi-dimensional hazards, driving mechanisms and intervention optimization paths of frequent high-fat and high-sugar takeaway consumption among urban middle-income adolescents from biological, economic, psychosocial and public health perspectives. Frequent unhealthy takeaway intake causes cumulative latent damage to adolescent metabolism, blood vessels and intestinal microecology. Although no obvious clinical symptoms appear in adolescence, it firmly lays the pathological foundation for adult chronic metabolic and cardiovascular diseases. The prevalence of unhealthy dietary behaviors is not a simple individual choice, but the result of the combined action of merchant low-profit operation models, platform algorithmic marketing incentives, and adolescent time-economic rational choices.

Existing multi-subject interventions have obvious structural advantages and defects. Government supervision has wide coverage but high implementation cost and poor individual behavioral correction effect. Platform self-regulation is flexible and innovative but restricted by profit-oriented business models, resulting in insufficient implementation intensity. Family and individual intervention is highly personalized but lacks long-term sustainability due to insufficient self-discipline. Price-based fiscal intervention is the most effective behavioral regulation method but faces great market and social resistance.

The core innovation of this study lies in constructing a holistic multi-disciplinary analytical framework for adolescent takeaway dietary risks, breaking the limitation of single-dimensional research in existing literature, and focusing on the understudied middle-income urban adolescent group. This study clarifies the full-chain mechanism from industrial economic drive to individual behavior and physiological health damage, and proposes hierarchical and targeted multi-subject collaborative intervention strategies. Despite the limitations of small-scale questionnaire samples and lack of empirical intervention verification, this paper provides a comprehensive theoretical reference and practical guidance for adolescent dietary health management and public health policy formulation. Future research can expand sample coverage and carry out empirical intervention experiments to further verify the actual effect of optimized regulatory strategies.

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